

Treatment of a Traumatic Carotid-Cavernous Fistula with a Covered Stent: Some Considerations

Case Report

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Summary

This article discusses some considerations concerning covered stent placement in a patient with a traumatic direct carotid-cavernous fistula. Our case supports recent reports in the literature that covered stent placement can be an acceptable alternative when detachable balloon occlusion or coil occlusion of a direct carotid-cavernous fistula fails or cannot be done. Positioning of a covered stent in the internal carotid artery can be technically challenging. No specific covered stents for neurovascular use have been designed or registered. Because of limited experience with covered stent placement in the carotid artery the optimal preventive and therapeutic strategies for thromboembolic complications are not known.

Introduction

A carotid-cavernous fistula (CCF) is an abnormal communication between the carotid artery and the cavernous sinus. Barrow et Al classified carotid-cavernous fistulas into four types, A-D 1. Type A carotid-cavernous fistulas are direct high flow shunts from the internal carotid artery (ICA) to the cavernous sinus. Trauma or rupture of a carotid-cavernous aneurysm are the most common causes of these fistulas^{1,2}. Traumatic direct CCFs are mostly unilaterally located. Indirect carotid-cavernous fis-

tulas (Barrow et Al type B-D) are dural arteriovenous shunts and are associated with slower filling of the cavernous sinus. These fistulas can occur spontaneously and the etiology of these fistulas is mostly idiopathic. Indirect CCFs can resolve spontaneously. The clinical presentation of a CCF is related to the size of the fistula and the type of venous drainage. The main venous drainage routes are to the contralateral cavernous sinus, the superior ophthalmic vein and the superior and inferior petrosal sinus. This can lead to a variety of symptoms such as visual loss, proptosis, bruit, cranial nerve impairment or intracerebral hemorrhage³. Traumatic direct CCF-related symptoms frequently do not occur immediately but commonly develop after a few days.

Endovascular detachable balloon occlusion of the fistula is a widely accepted treatment of direct CCFs⁴. Transarterial or transvenous coil occlusion of the fistula is also commonly performed. Recently several reports in the literature promote covered stent placement as a successful alternative when detachable balloon occlusion or coil occlusion of the fistula fails or cannot be done^{3,5,6}. This article discusses some considerations in a case where we placed a covered stent to occlude a traumatic direct CCF. Although the procedure was challenging we successfully occluded the fistula. Unfortunately the patient suffered a thromboembolic event during this procedure.

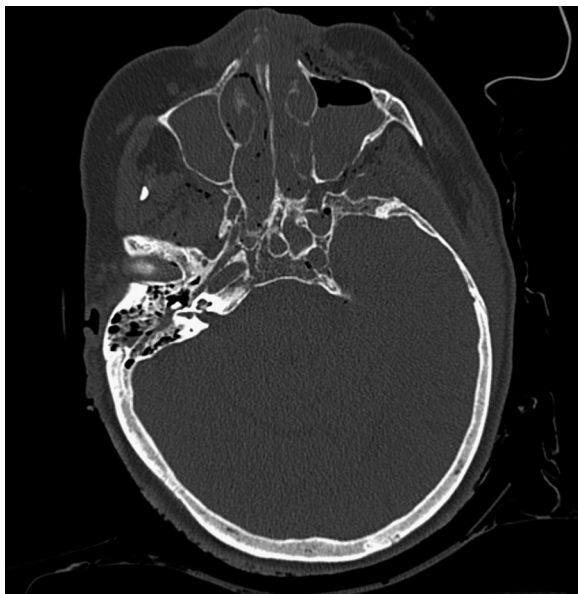


Figure 1 Facial and skull base fractures.

Case Report

A 78-year-old woman was admitted to our hospital after involvement in a motor vehicle accident. She presented at our emergency department with severe facial fractures (Figure

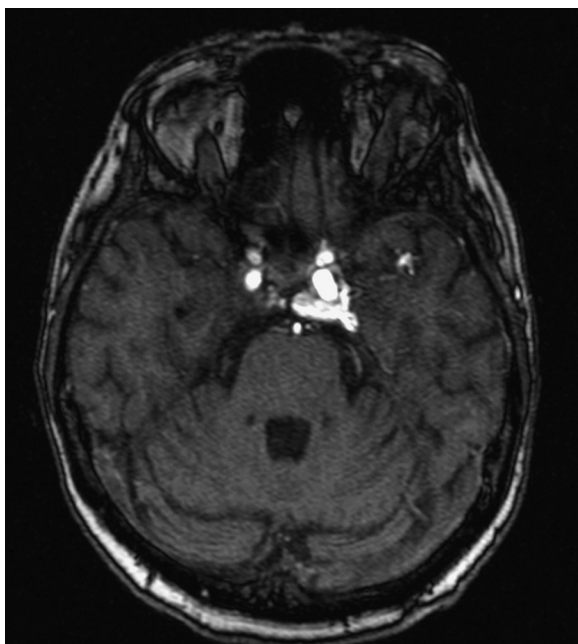


Figure 2 MRA showing high signal intensities suspect for a left side carotid-cavernous fistula.

1), a left frontal lobe hemorrhagic brain contusion, hemothorax, liver and spleen laceration, pelvic fractures and fractures of the forearm. The patient suffered partial left side optic nerve injury with visual field disturbance. Because of hemodynamic instability and severe epistaxis a head and neck angiography was performed. Injury of the left internal carotid artery was seen located in the carotid canal. Because of hemodynamic stabilization of the patient during the procedure and a hypoplastic right side A1 segment the interventional radiologist on call decided not to perform a parent vessel occlusion of the internal carotid artery and the epistaxis was treated conservatively. A few hours later the patient underwent splenectomy and surgical treatment of the liver injury because of intra-abdominal bleeding. The patient slowly recovered on the ICU in the days following. She had clinical follow-up of her internal carotid artery injury.

During admission the patient developed dizziness, gradual loss of vision of her left eye, painful eye movements and periorbital swelling. Ophthalmic examination one month after admittance showed left side thickened episcleral vessels, raised intraocular pressure (38 mmHg), no light perception and proptosis. An MRA showed high signal intensities in the left cavernous sinus suspect for a CCF (Figure 2).

At angiography under general anesthesia the CCF was confirmed (Figure 3), located in the cavernous portion of the ICA with outflow to the superior ophthalmic vein, the pterygoid plexus, the superior petrosal sinus and the contralateral cavernous sinus. The decision was made to close the fistula by endovascular means. Although the opening of the fistula was clearly visible, it was impossible to reach the cavernous sinus from the arterial side with microcatheters. Next a venous approach was tried. The cavernous sinus was reached with a guidewire but again failure to pass a microcatheter because of stenosis in the superior petrosal sinus. There was no admittance to the inferior petrosal sinus. Because of the long procedural time of six hours the procedure was terminated.

In the days following the patient suffered worsening of her ocular symptoms. Head CT scan showed a new small hemorrhage in the region of the dentate nucleus on the left side (Figure 6). The option for covered stent placement was discussed. Because of the new hemorrhage the decision was made not to perform this pro-



Figure 3 Left internal carotid angiogram, A) anteroposterior and B) lateral views, showing a left side direct carotid-cavernous fistula (arrow) with drainage to the contralateral cavernous sinus (small arrow) and to the superior petrosal sinus (double arrow).

cedure right away. One week later this endovascular treatment was performed with the informed consent of the patient. During this procedure the initial stent chosen, a 5 mm x 16 mm Advanta V12 covered stent (Atrium Medical), failed to pass the petrosal segment of the ICA. This stent was replaced by a 4.5 mm x 16 mm coronary Jostent (Abbot Vascular) but again the same problem was encountered. Next a 4 mm x 16 mm coronary Jostent passed this portion of the ICA and was placed over the fistula (Figure 4). After deployment of this balloon-mounted stent there was no complete adherence of the stent against the vessel wall. Unfortunately the guide wire was accidentally pulled back below the stent and it took some time to reposition this guide wire to insert a 5 mm x 20 mm balloon for further expansion of the stent. Eventually after further balloon dilatation the fistula was successfully occluded (Figure 5).

One day prior to treatment a dose of 300 milligram acetylsalicylic acid (Ascal) had been administered intravenously. During the procedure systemic 9000 units of heparin were given and just after the procedure 150 milligram lysine-acetylsalicylic acid (Aspégic) were administered intravenously. For three months after the procedure the patient was given 100 milligram acetylsalicylic acid (Aspirin) and 2850 units of low molecular heparin. Because of the small hemorrhage no clopidogrel (Plavix) was given in the period before and after stent placement.

Unfortunately the patient had aphasia and right side hemiparesis after this nine hour procedure. Head CT scan showed a small left parietal lobe infarction (Figure 7). There was improvement of her hemiparesis and aphasia during admittance. Follow-up ophthalmic examination showed normalization of the intraocular pressure, improvement of eye movements but no improvement of vision. The patient was transferred to a rehabilitation clinic. During clinical follow-up of nine months no recurrence of her ocular symptoms was reported.

Discussion

A traumatic direct CCF requires treatment because of the morbidity it causes and the low incidence of spontaneous resolution⁵. Preferably these fistulas should be treated as soon as possible to prevent further morbidity. Our patient suffered a left sided traumatic direct CCF after a motor vehicle accident. The ICA injury seen on initial angiography was not recognized as a CCF. Probably care concerning hemodynamic stabilization of this multitrauma patient had drawn attention away from the ICA injury. Retrospectively we can debate whether the fistula should have been treated earlier with an attempt to perform a detachable balloon occlusion of the fistula to prevent morbidity. The relatively small hole fistula could be the result of a tear of a dural branch of the cavernous ICA or



Figure 4 A,B) Covered stent (4 mm x 16 mm Jostent) placement in the left internal carotid artery.

from an unusual tear of the dorsal wall of the cavernous ICA which would made the treatment with a detachable balloon impossible. Covered stent placement in the acute phase was contraindicated because of multi organ injuries.

Our patient was treated with covered stent

placement because of transarterial and transvenous access failure. The covered stent placement was challenging but finally successful. This supports recent reports in literature that covered stent placement can be a good alternative when detachable balloon occlusion or coil oc-

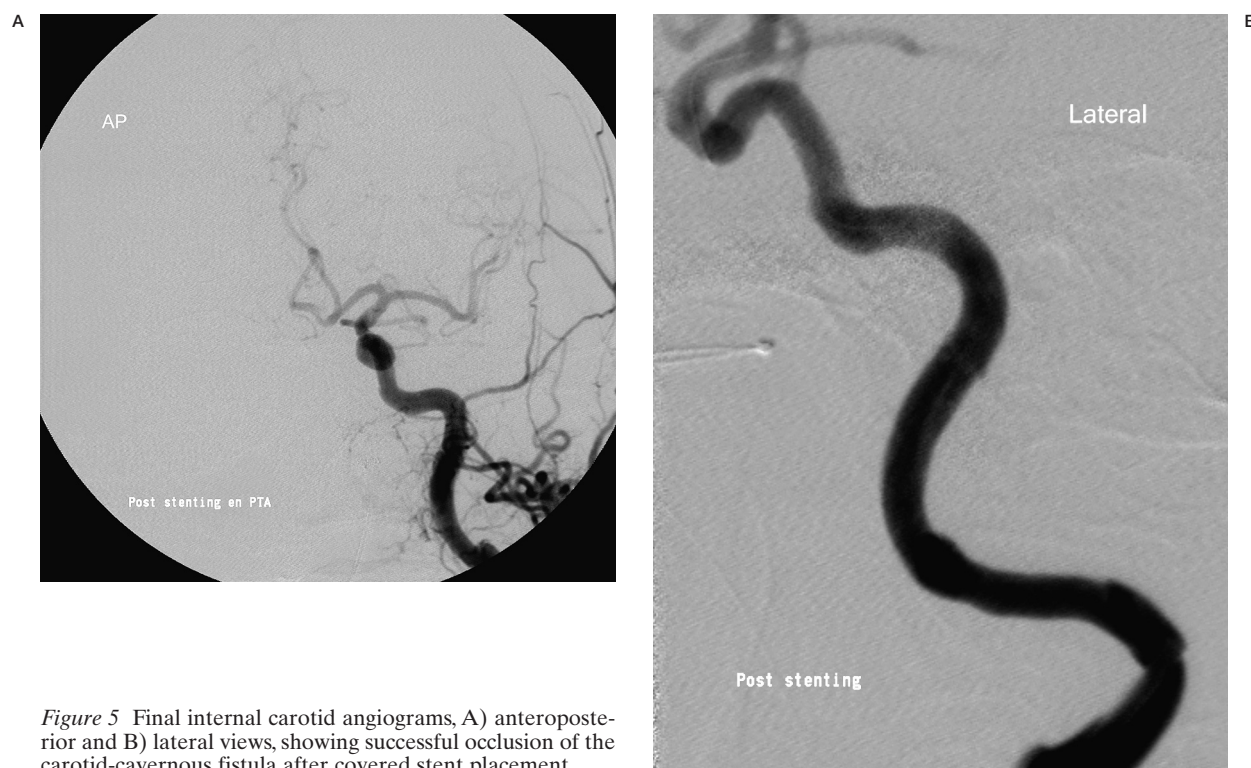


Figure 5 Final internal carotid angiograms, A) anteroposterior and B) lateral views, showing successful occlusion of the carotid-cavernous fistula after covered stent placement.

clusion of the fistula fails or cannot be done. A limitation of the introduction of an endovascular prosthesis is the risk for additional injury to the vessel wall. In our case this risk could be even higher because no covered stents have been designed or registered for neurovascular use³. Cardiac covered stents are small but relatively stiff stents which are difficult to navigate through the stiff petrosal-cavernous portion of the ICA. A relatively flexible stent such as the Jostent (Abbot Vascular) or Symbiot stent (Boston Scientific) is preferred^{7,8}. Stiffness of the stent limits the diameter of the stent that can be used. In our case we failed to pass a 4.5 mm Jostent although the size of this stent would have been preferred. Finally a 4 mm Jostent was successfully positioned and deployed over the fistula. Archondakis reported two cases in which there was residual flow between the covered stent and the fistula with a persisting low flow CCF³. Further expansion of the stent by balloon dilatation was successful in our patient.

Although there is little known about the long-term patency of covered stents in the cerebral arteries Felber et Al suggest good patency in five years follow-up⁹.

For endovascular procedures it is important to have control over the materials used at any time. In our procedure we lost control over the guide wire which was accidentally pulled back below the stent. It took a long time to reposition the guide wire to pass a balloon for further expansion of the stent. This prolonged the procedural time. Unfortunately our patient suffered ischemia in the left hemisphere, probably because of a thromboembolic event during this long-lasting procedure.

To prevent thromboembolic complications it is important to have anticoagulation and antiplatelet strategies optimized for the specific endovascular procedure, to minimize endovascular manipulation and to have the procedural time as short as possible. Extensive research has been performed to elucidate the pathophysiological features underlying thrombosis associated with endovascular procedures. The preventive and therapeutic regimens used during endovascular procedures are empirically derived¹¹. Accordingly there is great variation in protocols and schemes presented in the literature. Qureshi et Al proposed recommendations for preventive and therapeutic strategies for thromboembolic complications associated with specific endovascular procedures^{11,12}. These

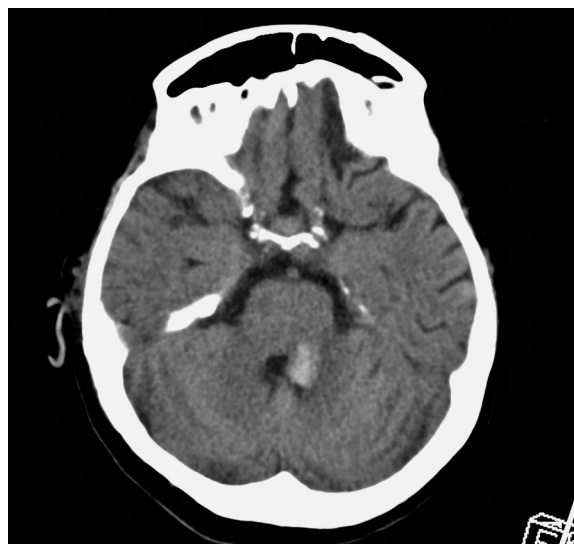


Figure 6 New small hemorrhage in the region of the left dentate nucleus.

recommendations are based on an extensive review of basic pathophysiological and clinical studies. Preventive and therapeutic strategies for thromboembolic complications associated with covered stent placement in cardiovascular diseases have been published but not for carotid artery covered stent placement. In post-traumatic patients the antiplatelet and anticoagulation medication regimen to be used is less clear because these patients have a higher risk

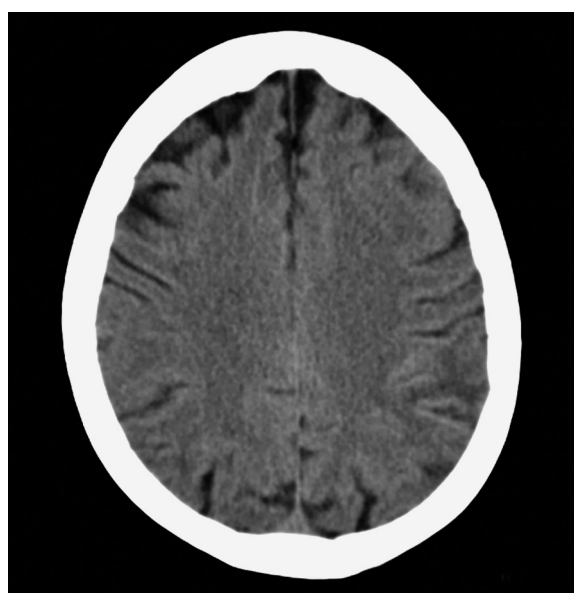


Figure 7 Ischemia in the left hemisphere (arrow).

of hemorrhage. In our case no clopidogrel was given because of a new hemorrhage in the region of the left dentate nucleus. Considering the difficulties we encountered in this procedure we certainly would have considered more extensive antiplatelet therapy.

Conclusions

Traumatic direct carotid-cavernous fistulas should be recognized in time and treated as soon as possible because of the serious morbid-

ity they cause and the low incidence of spontaneous resolution. Our case supports recent reports in the literature that covered stent placement can be an acceptable alternative when detachable balloon occlusion or coil occlusion of a direct carotid-cavernous fistula fails or cannot be done. Covered stents designed and registered for neurovascular use are desired. Research focused on long term outcome, stent patency and procedural morbidity is necessary for covered stent placement in direct carotid-cavernous fistulas.

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